

Don R.

Don R.
Division of Laboratories



BIOLOGICAL SURVEY

OF THE

GERMAN MILLS CREEK

1965

ONTARIO WATER RESOURCES COMMISSION

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BIOLOGICAL SURVEY

of

GERMAN MILLS CREEK

a branch of the

DON RIVER

1965

by

M. G. Johnson and G. E. Owen

BIOLOGY BRANCH

February, 1966

BIOLOGICAL SURVEY OF GERMAN MILLS CREEK - 1965

A biological survey of German Mills Creek was carried out in September, 1965, to supplement an assimilation study completed in May, 1965 by the Water Quality Surveys Branch, Sanitary Engineering Division. Biological parameters are useful in assessing water quality because they integrate water quality over a period of several months prior to the survey. As well, biological data provide direct evidence of damage because of impaired water quality.

DESCRIPTION OF STREAM

The stream rises within the municipal boundaries of the Town of Richmond Hill. At the time of the biological survey, immediately below Richmond Hill, the stream flowed at a rate of about 2 cfs in a channel 3 feet wide and $1\frac{1}{2}$ feet deep. Most of the volume was treatment-plant effluent from the activated sludge plant in Richmond Hill which has a present capacity of 1.6 mgd.

The flow increased in volume to about 4 cfs between Stations C and E. The East Branch of the Don River below the entry of German Mills Creek was 20 feet wide and 1.5 feet deep with a volume of 18 cfs at Station F (Fig. 1).

The adjacent tributary on which Stations F and G were sited had a greater rate of flow than German Mills Creek (4 to 5 times) but received no major contribution of municipal wastes.

German Mills Creek flows through agricultural land in Markham Township. However, within 1 mile of Metropolitan Toronto and in northern Metropolitan Toronto the stream flows through a deeply-cut valley. Much of the table land has been subdivided for residential

Fig. 1

DON RIVER

GERMAN MILLS CREEK

stations °

scale

1 MILE

RICHMOND HILL

STP

A

B₁

B₂

C

H

MARKHAM TWP.

VAUGHAN TWP.

THORNHILL

D₁

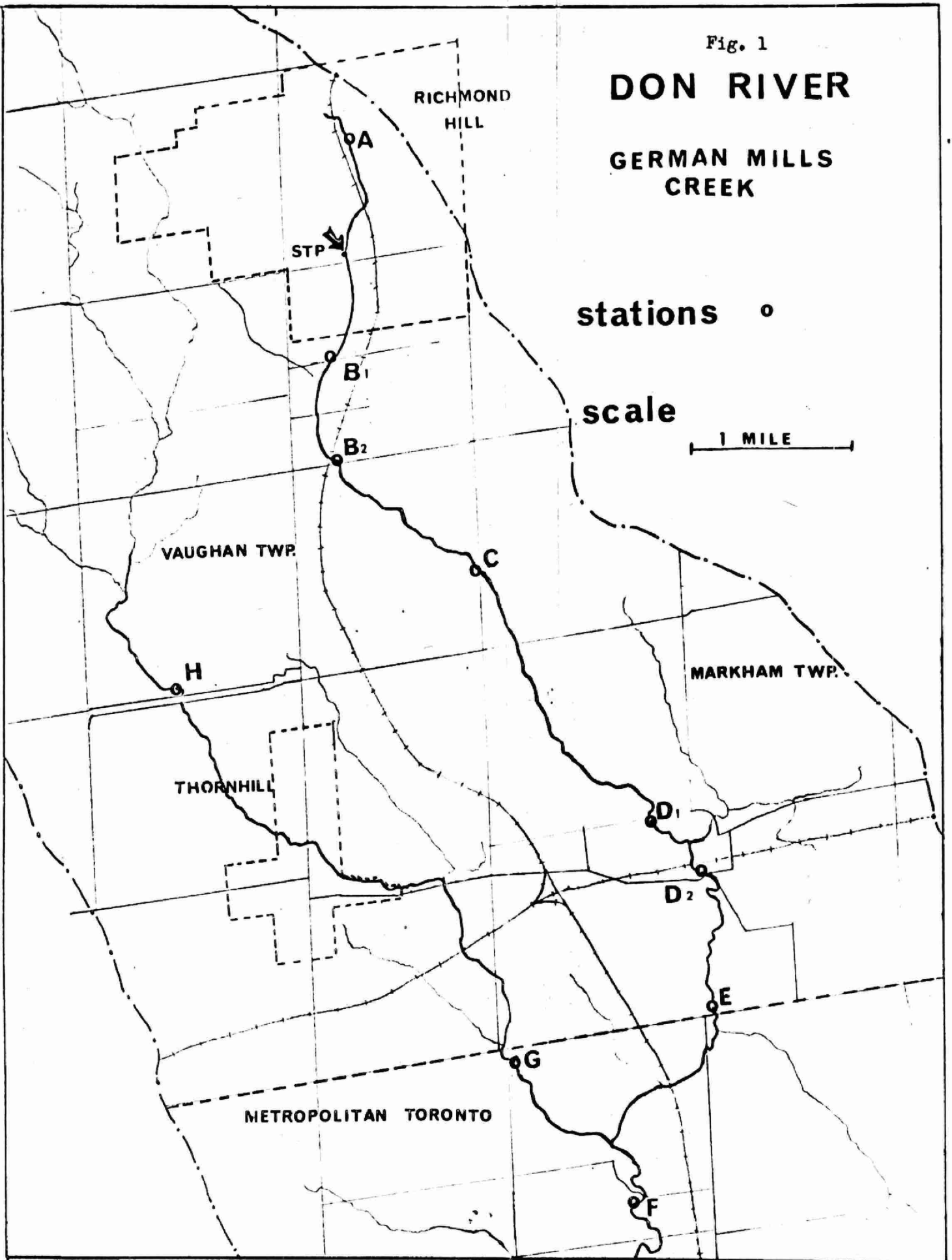
D₂

E

G

METROPOLITAN TORONTO

F



use. The valley is designated as park land and the Metropolitan Toronto and Region Conservation Authority will construct a reservoir on the East Branch of the Don River. The 60-foot dam will impound approximately 300 acres for flood storage and maintain a 65-acre recreational lake. The Parks Department of Metropolitan Toronto will develop park lands surrounding the lake.

METHODS

Bottom fauna and fish populations were examined at six stations on German Mills Creek, one station downstream on the East Branch of the Don River (Little Don River) and two "control" stations on the main tributary (Fig. 1). Station A, at a point above the OWRC-Richmond Hill S.T.P., was dry at the time of the survey. Bottom fauna and fish were sampled as follows:

Bottom fauna

One collection consisting of 20 minutes of effort in all common habitats with a 20-mesh (per inch) seive was made at each station.

Fish

Population estimates were attempted using the removal method at Stations B1 to F (except D2) on German Mills Creek. Sections of stream varying from 300 to 350 feet in length were blocked at upstream and downstream ends. Three collections of uniform effort were made at each; the fish were retained and estimates of the total population were made on the basis of diminishing catch (Johnson, 1965). No fish were taken in the first unit of effort at Stations B1, B2 and C, therefore, fishing was discontinued at each. At Stations G and H about 20 minutes of electrofishing and seining at each provided qualitative data for comparison purposes.

BIOLOGICAL ASSESSMENT OF WATER QUALITY

The effluent from the OWRC - Richmond Hill S.T.P. comprised most of the flow in the upper reaches of German Mills Creek. The

use. The valley is designated as park land and the Metropolitan Toronto and Region Conservation Authority will construct a reservoir on the East Branch of the Don River. The 60-foot dam will impound approximately 300 acres for flood storage and maintain a 65-acre recreational lake. The Parks Department of Metropolitan Toronto will develop park lands surrounding the lake.

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BIOLOGICAL ASSESSMENT OF WATER QUALITY

The effluent from the OWRC - Richmond Hill S.T.P. comprised most of the flow in the upper reaches of German Mills Creek. The

bottom fauna community was restricted to a small number of tolerant species. Only midge larvae, tubificids, two genera of beetles and the rat-tailed maggot, Eristalis, were collected at Stations B1 and B2. Some improvement was noted at Stations C and D1 with the presence of a mayfly of the genus Cloeon, and the damselflies, Enallagma and Ischnura. However, large populations of midges at these stations indicated considerable organic enrichment. At Station D2 midges were less numerous, but only one additional invertebrate of moderate tolerance was noted, the dragonfly, Aeschna. The presence of large numbers of blackfly larvae from Station D1 downstream indicated enrichment throughout the lower reaches of German Mills Creek and, in fact, in the East Branch of the Don below the entry of the former. No evidence of further improvement was noted at Station E. Probably an important effect of water quality on the biota was caused by the abundance of nutrients in promoting excess production of plant material and periodic secondary organic loading in the stream.

Moderate impairment was evident at Station F. Caddisflies of two genera and one moderately-tolerant mayfly were present. The other forms which were common were of the tolerant groups, midges, tubificids and leeches. However, a close resemblance of the communities at Station F, G and H indicated that the entry of water of poor quality from German Mills Creek had no severe effect on the East Branch of the Don River.

Water samples were taken at the time of the biological survey and the results are useful in the interpretation of the biological data (Tables 1 and 2). The high concentration of free ammonia and very low

Table 1. Determinations of BOD, solids, pH, detergent and phosphorus and nitrogen fractions on samples collected at nine stations at the time of the biological survey, September, 1965.

Biological Survey Station	5-day BOD	Solids			pH at lab	Anionic detergents as ABS	Phosphorus as PO ₄			Nitrogen as N		
		Tot.	Susp.	Diss.			Tot.	Sol.	Free Ammonia	Total Kjeldahl	Nitrite	Nitrate
B 1	8.2	-	3	767	7.5	5.0	34.0	28.0	6.56	3.40	0.3	10.0
B 2	7.6	-	5	787	7.6	4.6	60.0	30.0	7.22	12.00	0.6	8.0
C	12.0	-	38	762	7.2	3.8	36.0	29.0	7.22	11.00	0.4	10.0
D 1	3.4	-	9	801	7.6	3.6	29.0	27.0	0.26	2.45	0.3	13.0
D 2	2.2	-	23	803	7.7	3.6	29.0	26.0	0.13	2.45	0.1	13.0
E	1.8	-	25	703	7.6	2.4	14.0	12.0	1.00	1.65	0.1	10.0
F	2.4	-	35	467	7.8	0.7	23.0	20.0	tr	0.91	tr	3.5
G	1.4	-	41	373	8.0	0.0	0.3	0.2	0.06	0.33	tr	tr
H	1.2	-	55	307	8.0	0.0	0.3	0.1	0.05	0.40	tr	0.0

Table 2. Concentrations of dissolved oxygen observed in German Mills Creek and the main tributary of the East Branch of the Don River in May and September, 1965.

<u>Station</u>	Dissolved oxygen determined by Water Quality Surveys Branch 1			Dissolved oxygen determined by Biology Branch 2
	<u>Average</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Minimum</u>
B 1	4.7	6.2	2.2	1.0
B 2	4.4	7.2	1.9	1.1
C	6.4	9.3	4.2	0.8
D	6.5	9.8	4.4	2.7
E	8.7	11.2	3.2	2.7
F	-	-	-	3.2
G	-	-	-	3.3
H	-	-	-	3.5

1 Obtained from determinations made every two hours through the period May 26 to 28, 1965.

2 Single determinations made just before dawn on September 15, 1965.

Table 3. Mean concentrations of BOD, solids and nitrogen fractions made on series of four to twelve samples collected in May, 1965, by the Water Quality Surveys Branch.

Water Quality Survey Station	5-day BOD	Solids			NITROGEN (ppm as N)			
		Tot.	Susp.	Diss.	NH ₃	TKN	NO ₂	NO ₃
3 (B1)	39.5	801	61	740	20.1	36.0	0.4	0.3
4 (B2)	35.8	830	56	774	22.7	32.0	0.3	0.3
5 (C)	20.0	782	23	758	18.8	25.0	0.5	0.4
6 (D1)	17.9	722	17	705	18.1	20.8	1.3	1.2
8 (E)	11.9	653	19	634	9.6	14.5	1.5	1.0

concentrations of oxygen in the upper reaches are inhibitory to all but the most tolerant forms.

The levels of nitrogen and phosphorus were much greater than would be expected. For example, a secondary-treatment-plant effluent contains little more than 25 ppm of total phosphorus. However, land drainage and scouring of deposits because of previous rainfall and increased flows probably accounted for the high concentrations of phosphorus observed in both tributaries.

The Water Quality Surveys Branch conducted an assimilation study on German Mills Creek in late May, 1965. The results (Tables 2 and 3) agree only generally with those taken in September by the Biology Branch, as noted in comparing such results as BOD and free ammonia, both of which were much greater in the May samples. However, both sets of data indicate excessively high concentrations of organic matter and nutrients and a sag in the diurnal dissolved oxygen cycle to a very low level.

The data on invertebrates have been summarized and presented graphically (Fig.2) to demonstrate the general effect of the effluent on the biota of German Mills Creek. The increase in number of forms downstream and decrease in number of individuals collected per unit of effort are obvious. The data indicated that (during 1965) impairment of water quality occurred throughout the total length of German Mills Creek. The effects were severe throughout the first 2 miles (Stations B1 to C) and were attributed directly to domestic wastes, with demonstrable high levels of free ammonia (7 ppm) detergent (4 to 5 ppm as ABS) and very low concentrations of oxygen (1 ppm). Between Stations C

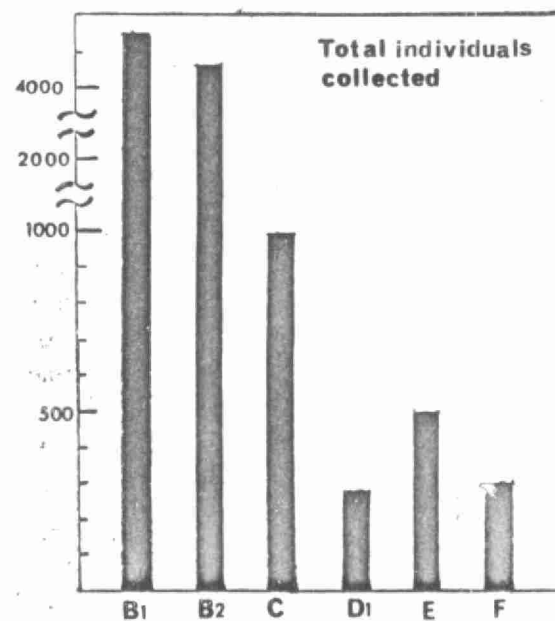
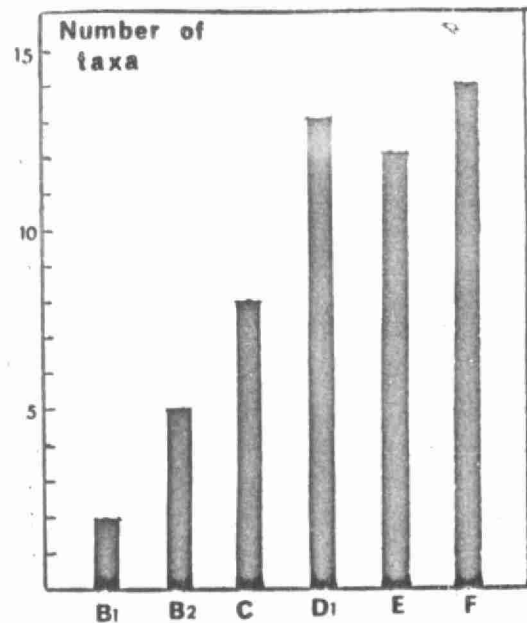


Fig. 2. Number of taxa (genera except families in the case of midges, tubificids and corixids) and individuals collected from the bottom fauna at six stations on German Mills Creek in September, 1965.

and E moderate impairment was indicated, to a degree indirectly because of enrichment. Although the BOD was not notably high (2 to 3 ppm) at the time of the biological survey, minimum concentrations of oxygen were rather low (3 ppm) presumably because of the respiratory demands by the abundant vegetation. The East Branch of the Don River showed little difference above and below the entry of German Mills Creek, but enrichment was indicated and the concentration of nutrients was high.

Data on fish populations support the preceding conclusions. Fish were absent throughout a length of 4 miles below Richmond Hill (Fig. 3). Three tolerant species, the creek chub, common sucker and blacknose dace had invaded Station D1 in low numbers. Four species were present at Station E in a population of average size. In the East Branch of the Don River six species were taken at Stations F, G and H. These findings support the earlier conclusion that German Mills Creek had no severe effect on the East Branch. However, the data on both invertebrates and fish demonstrate that water quality in the East Branch was mediocre. Although the East Branch was used only to provide comparative data and did not appear to be grossly affected by German Mills Creek, its water quality based on biological parameters must be rated as only fair.

SIGNIFICANCE OF BIOLOGICAL RESULTS

The nutrient-rich flow from the German Mills watershed will have significant effects on the reservoir to be developed downstream. Growths of algae and vascular plants likely will recur periodically

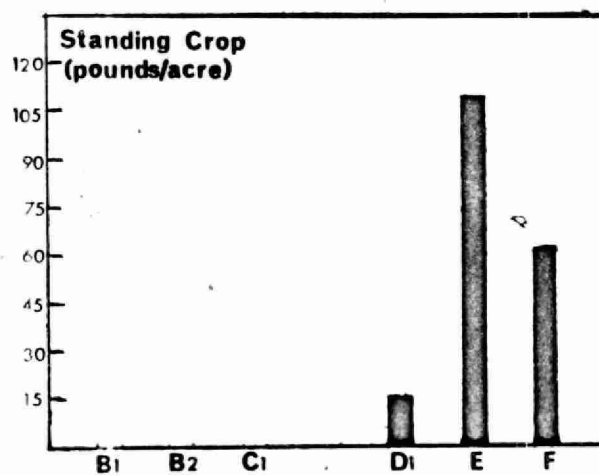
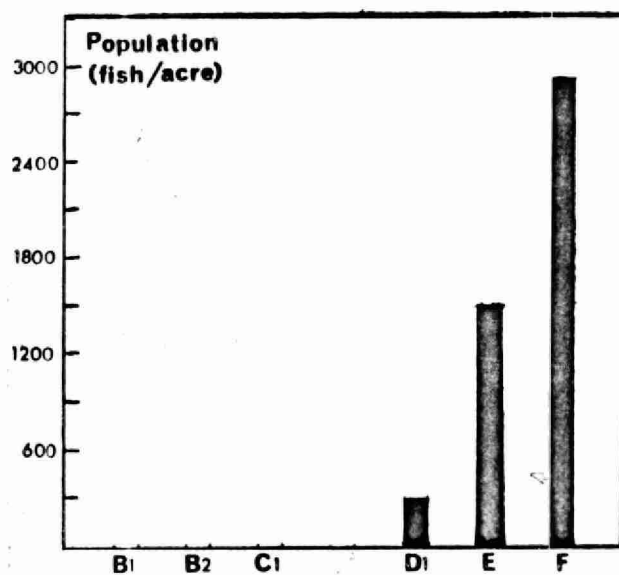
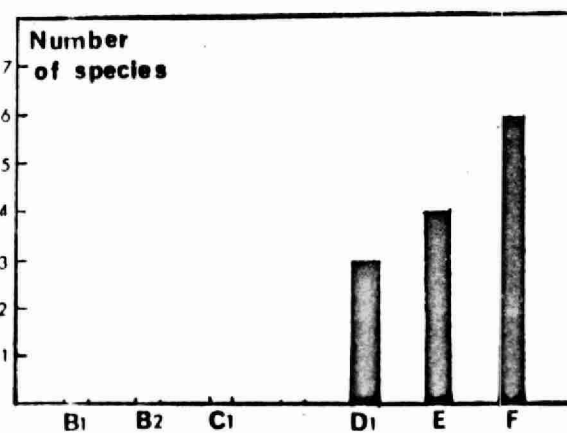
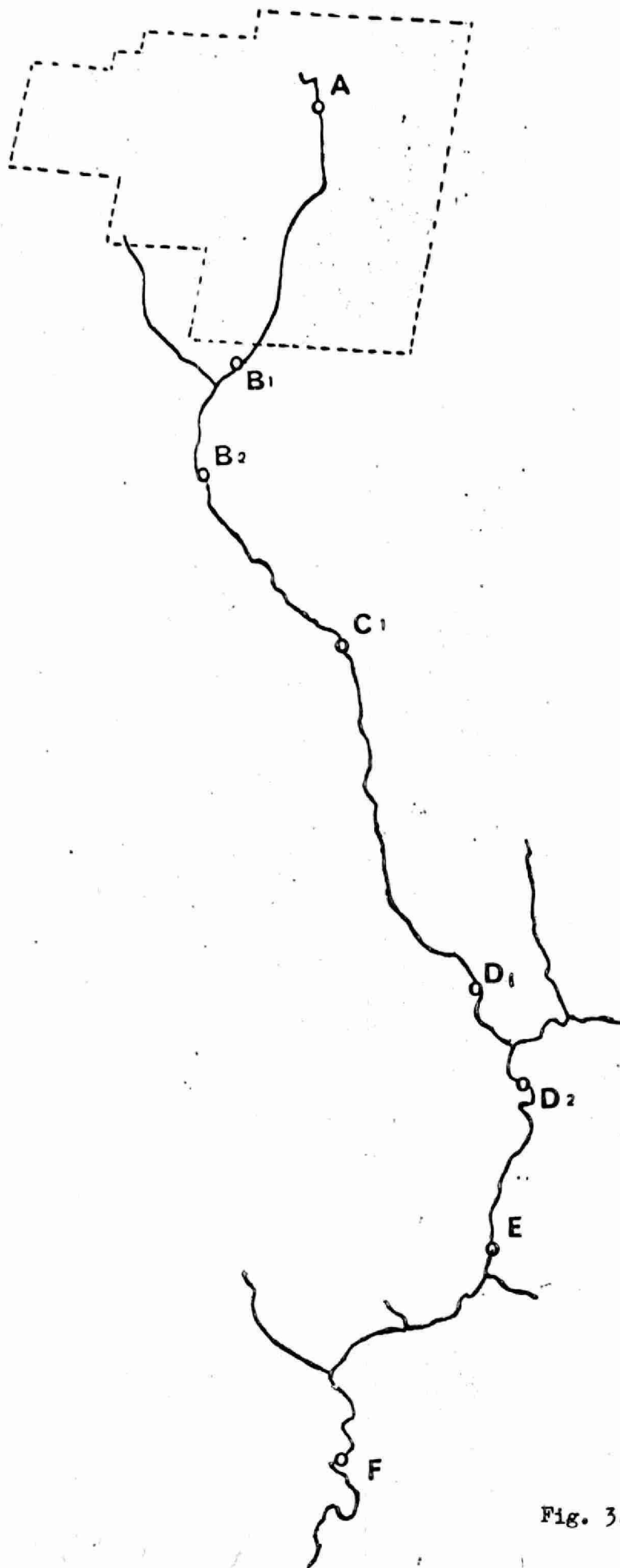


Fig. 3. Number of species, fish per acre and standing crops of fish estimated at stations on German Mills Creek in September, 1965.

and will interfere with full use of the lake as a recreational facility. Although the Conservation Authority does not expect swimming to be provided, an attractive environment for picnicking, boating and fishing is desired.

German Mills Creek was included in a separate study on the yield of phosphorus which has been carried out by the Biology Branch in co-operation with the Water Quality Surveys Branch. The annual yield of phosphorus from the upper 4.5 square miles of the watershed (north of Highway 7) was estimated as 90,000 pounds (PO_4). The yield (per square mile) was approximately 40 times greater from this watershed than from two "agricultural" watersheds in the same physiographic region.

A sewage treatment plant will be constructed on the main tributary south of Thornhill in 1966. The secondary effluent of 0.75 mgd will be "polished" by passage through an automatic back-wash sand filter. However, nutrients will not be removed and an additional yield of nutrients will result. This will probably be in the order of 55,000 pounds per year at plant capacity, assuming a concentration of phosphorus in the effluent of 20 ppm. The implications of adding about 70 tons of phosphorus in a steady supply each year to a relatively small lake should be apparent (comparable to adding 6,000 bags of superphosphate fertilizer). In conclusion, the biological survey indicated that water quality in the first 4 miles of stream below Richmond Hill was extremely poor, and that some improvement occurred through the downstream portion. Self-purification was not completed at the confluence with the main tributary. The East Branch

of the Don River did not appear to be affected severely by the contribution from German Mills Creek, although some enrichment was noted. However, the quality of water in the main tributary probably was only fair. The probability of substantial problems associated with excess production of aquatic vegetation in the reservoir to be constructed on the East Branch of the Don River must be noted.

REFERENCES

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- Metropolitan Toronto and Region Conservation Authority. 1963. Pollution control and recreation in the Metropolitan Region, June, 1963, 52 pp.

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APPENDIX

Table 1. Specimens collected at 9 stations on German Mills Creek and the main tributary of the East Branch of the Don River in September, 1965. Collecting methods are outlined in the text of the report. The specimens have been placed in the permanent collection of the Biology Branch as items 65B94 to 65B103.

Table 2. Estimated numbers (per acre) of fish at 3 stations on German Mills Creek as determined using the removal method, September, 1965.

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Table 1. Specimens collected at 9 stations on German Mills Creek and the main tributary of the East Branch of the Don River in September, 1965. Collecting methods are outlined in the text of the report. The specimens have been placed in the permanent collection of the Biology Branch as items 65B94 to 65B103.

Group	Taxa	Stations								
		B1	B2	C	D1	D2	E	F	G	H
MAYFLIES	<u>Cloeon</u>			4	3	2			7	4
	<u>Baetis</u>							32		
	<u>Callibaetis</u>						1			
CADDISFLIES	<u>Cheumatopsyche</u>							4	4	25
	<u>Hydropsyche</u>							2	2	80
	<u>Hydroptila</u>							6	1	
DAMSELFLIES	<u>Enallagma</u>			1	25	15	7			
	<u>Ischnura</u>				4	3	2			
DRAGONFLIES	<u>Aeshna</u>					1	2			
FLIES	<u>Eristalis</u>		8							
	<u>Simulium</u>			9	131	417	443	210	2	
	<u>Culex</u>			11	2		1			
	<u>Palpomyia</u>				1					
	<u>Chrysops</u>						8	1		
	Tendipedidae	5452	4488	946	108	58	48	31	9	42
BUGS	<u>Notonecta</u>				1					
	<u>Corixidae</u>					1	1			11
	<u>Gerris</u>								1	
	<u>Ochterus</u>									1
BEETLES	<u>Rhantus</u>	8	24	2	1		1			
	<u>Galerucella</u>		8							
	<u>Laccophilus</u>			3	2					
	<u>Tropisternus</u>				2	1				
ISOPODS	<u>Asellus</u>							1		2
NEMATOMORPHS	<u>Gordius</u>									1
LEECHES	<u>Helobdella</u>							1		1
	<u>Placobdella</u>							1		
	Unidentified genus							5	4	
MOLLUSCS	<u>Gyraulus</u>				1				1	
	<u>Physa</u>					1	5	8	8	21
	<u>Ferrissia</u>							1	3	
	<u>Sphaerium</u>								1	
	<u>Helisoma</u>									4
TUBIFICIDS	Unidentified		65	9	3	7	4		14	2

APPENDIX

Table 2. Estimated numbers (per acre) of fish at 3 stations on German Mills Creek as determined using the removal method, September, 1965.

Species	Stations		
	D1	E	F
White sucker	330	629	317
Common shiner			205
Blacknose dace	127	716	466
Longnose dace		34	1810
Creek chub	51	34	112
Johnny darter			19
Total numbers	508	1413	2929

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